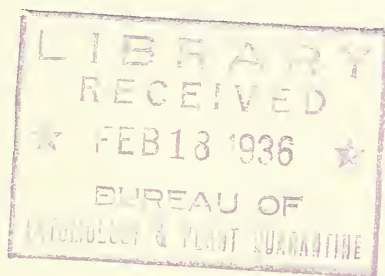


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THE INSECT PEST SURVEY
BULLETIN



Volume 15

Supplement 2

Number 9

BUREAU OF
ENTOMOLOGY AND PLANT QUARANTINE
UNITED STATES
DEPARTMENT OF AGRICULTURE
AND
THE STATE ENTOMOLOGICAL
AGENCIES COOPERATING

INSECT PEST SURVEY BULLETIN

DECEMBER 1935

Vol. 15

Supplement

No. 9

COLONIZATION OF FOREIGN PARASITES OF THE EUROPEAN CORN BORER IN THE
UNITED STATES FOR 1935

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This report summarizes the progress made in 1935 in the distribution of exotic species of parasites of the European corn borer, in both the one- and two-generation areas, as a continuation of the 1934 program. Except for subordinating other considerations to the efficient handling of Inareolata punctoria Roman., the promising European ichneumonid, no change in the 1934 procedure was made. The total releases in 1935 are presented in table 1, and the total releases to December 31, 1935, since the inauguration of parasite activities, are presented in table 2.

In addition to the parasite material imported from Europe through the facilities of the Division of Foreign Parasite Introduction, a supply of Cremastus flavoorbitalis (Cam.) was made available through the cooperation of the Canadian Department of Agriculture, Entomological Branch, in continued importations of parasite material from the Orient. This species was desired particularly for release in more southern sections now infested by the borer.

^{1/}D. W. Jones, C. A. Clark, and E. D. Burgess assisted in the release of the parasites in the regions of their respective assignments.

Table 1.--Summary of releases of imported parasites in 1935

State	: Lydella : stabulans var. : griseus	: Inareolata: : punctoria:	: Cremastus: : flavoor-: : bitalis :	: Bracon : atricornis:	Total
Connecticut----	1,823	1,138	771	7	3,739
Indiana-----	11,904	--	--	--	11,904
Maine-----	1,927	--	--	--	1,927
Massachusetts--	7,824	--	--	--	7,824
Michigan-----	5,980	--	--	--	5,980
New Hampshire--	5,569	--	--	--	5,569
New Jersey-----	6,461	565	593	--	7,619
New York-----	11,767	1,712	600	--	14,079
Ohio-----	25,898	3,888	--	--	29,786
Vermont-----	9,813	--	--	--	9,813
Virginia-----	3,956	--	600	--	4,556
Total-----	92,922	7,303	2,564	7	102,796

Table 2.--Total releases of imported parasites in United States to December 31, 1935

State	Apanteles sp. (Oriental)	Apanteles (Thompson) Lytle (European)	Bracon stricicornis (Smith) (Oriental)	Bracon stricicornis (Smith) (European)	Campoplex multi- cinctus Grev.	Campoplex pyraustae Smith	Chelonus annulipes Wesm.	Chremastus flavoor- ditalis Jamer.	Bulimneria alkae (Elli. & Saecht.) (European)	Bulimneria alkae (Elli. & Saecht.) (Oriental)	Eulophus viridulus Thoms.	Exeristes reporator Fab.	Inareolata punctoria Roman. (European)	Inareolata punctoria Roman. (Oriental)	Lydeila staculans var. gril- sacens R. Desc.
Conn---	---	21,268	12	---	---	---	2,224	1,483	889	168	17,200	---	5,719	1,163	31,847
Ind---	---	---	---	---	---	---	---	---	---	---	---	2,302	---	---	---
Maine---	---	5,700	---	---	---	---	2,259	---	5,161	---	6,671	22,905	5,989	---	22,921
Mass---	388	67,144	14	113	1,129	1,697	9,204	6,762	20,193	8,333	84,786	54,957	21,130	7,554	76,456
Mich---	---	34,837	---	---	---	---	6,363	---	24,075	---	44,037	86,607	7,158	---	115,129
N. H---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	5,569
N. J---	---	---	---	---	---	---	---	593	---	---	---	---	565	---	6,461
N. Y---	3	51,106	---	---	61	16	4,783	1,109	9,279	---	55,755	40,050	14,766	---	116,738
Ohio---	---	52,505	---	---	357	38	19,167	5,145	36,398	---	101,648	87,826	27,445	8,711	193,972
Pa---	---	5,774	---	---	---	---	---	---	550	---	---	20,119	707	---	8,369
R. I---	---	11,756	201	10	123	47	7,552	1,014	4,636	---	7,446	---	8,534	6,038	32,834
Vt---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9,813
Va---	---	---	---	---	---	---	---	600	---	---	---	---	---	---	3,956
Total---	391	252,090	227	123	1,670	1,798	51,555	16,706	101,181	8,501	317,543	314,766	92,013	23,466	625,922

Table 2. Total releases of imported parasites in United States to December 31, 1935 (cont'd)

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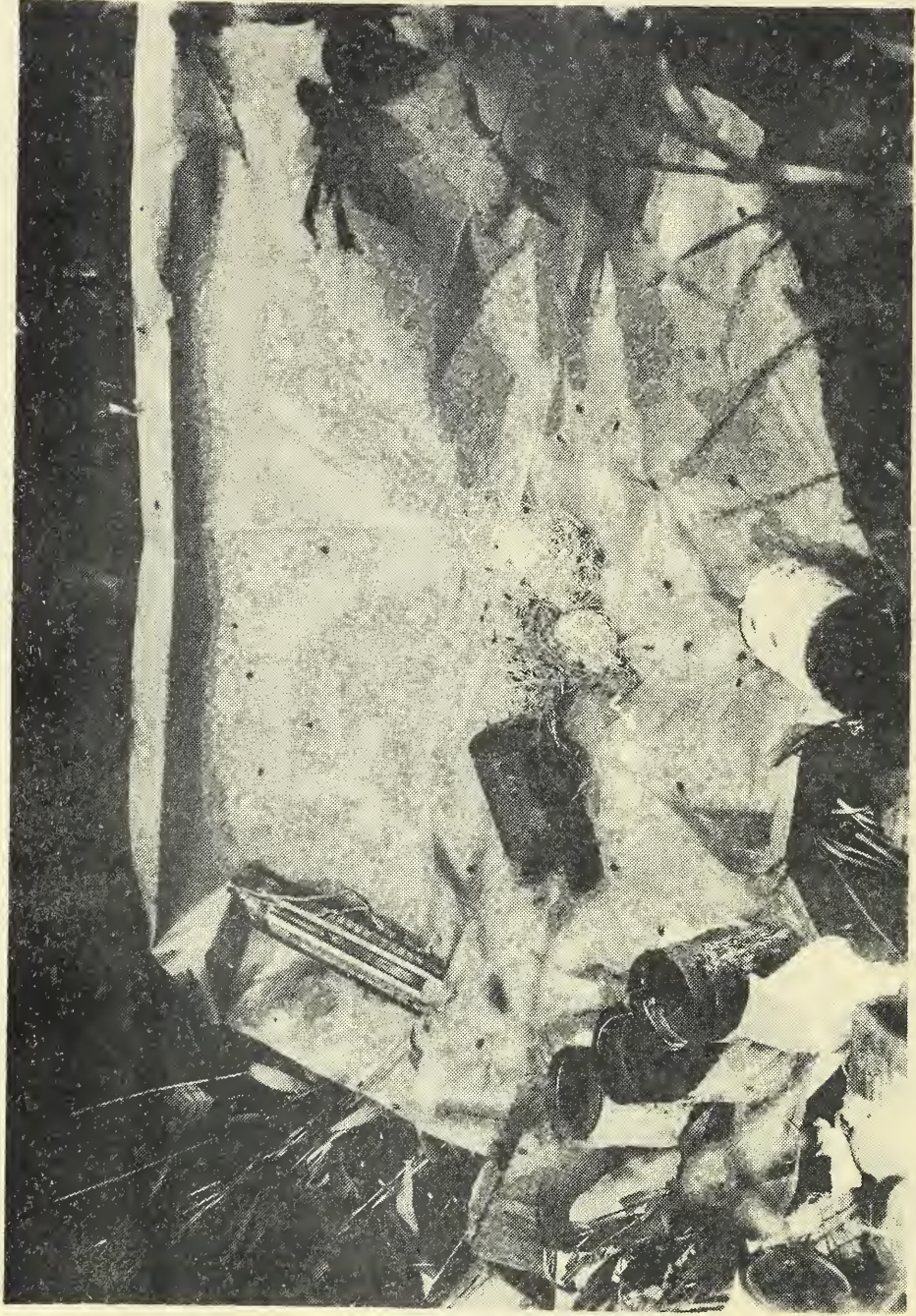


Fig. 1. Showing technique in releasing tachinids from shipping containers.

All parasites were taken to the point of release, in the containers in which they were packed for distribution at Moorestown, N. J., where all emergence was taken. Figure 1 shows the technique utilized in allowing tachinids to escape from the shipping container. A similar technique was utilized with the Hymenoptera.

In order to receive the maximum benefits from the parasite releases it is essential that these liberations be timed to synchronize the maximum oviposition period of the parasites with the optimum stage of host development to receive such ovipositions. A practical accomplishment of this synchronization is difficult for many reasons, as the following: (1) Specific information is lacking concerning the length of life and oviposition period of various species of parasites under field conditions; (2) the effect of seasonal variations in shifting the development of their host, the corn borer, under field conditions, cannot be foretold; (3) since obviously it is impossible to vary to any great extent the normal date of emergence of one species of internal parasite more than that of another after the host material has been placed in a developmental environment, this necessitates the selection for emergence that period which is optimum for the most important species expected to emerge from the material at hand.

However, all releases of corn borer parasites are timed to synchronize with the average first appearance of optimum host development, as this procedure has previously proved effective with releases; whereas, a number of past releases that have preceded or been delayed beyond this period have not proved successful. In planning the emergence schedule for 1935, major emphasis was placed on accomplishing the desired synchronization with respect to two species, namely, Inareolata punctoria from the Italian host material, for synchronization with third-instar larvae in both the one- and two-generation areas, and Gremastus flavoorbitalis from the oriental source, for synchronization with fourth-instar hosts in Canada. Fortunately, such factors as the demands of the different parasites for varying host stages, on which to oviposit, variations in the length of the developmental period of the host, and the duration of the preoviposition period, permitted a fairly close synchronization of all parasites as well as those selected for chief consideration.

The more pertinent information bearing on the accomplishments of the 1935 colonization program are presented in the following discussions:

1. Inareolata punctoria Roman. (Ichneumonidae):

Major emphasis was placed on the optimum handling of this parasite, as it was the least widely distributed of the parasites that have been demonstrated to be the most valuable species imported to date. A total of 7,303 adults were released in 13 colonies, 12 of which were dispersion colonies and 1 a supporting test release at Milford, New Haven County, Conn. Table 3 summarizes the releases of this species and map 1 indicates the extent of colonization prior to 1935, and the counties receiving releases during that season.

Table 3.--Releases of Inareolata punctoria in 1935

State	Township	County	Parasites liberated	Period of release (dates inclusive)
			Number	
Connecticut--	Milford	New Haven	552	July 12
	Haddam	Middlesex	586	July 20
Total---	--	--	1,138	July 12 - 20
New Jersey---	Brick	Ocean	565	July 5
Total---	--	--	565	Do.
New York-----	Berne	Albany	517	July 9
	Porter	Niagara	597	July 28
	Yates	Orleans	598	Do.
Total---	--	--	1,712	July 9 - 28
Ohio-----	Perkins	Erie	588	August 6
	German	Fulton	598	July 23
	Richmond	Huron	586	July 30
	Jefferson	Mercer	598	August 2
	Danbury	Ottawa	348	August 13
	Seneca	Seneca	583	July 30
	Willshire	Van Wert	587	August 2
Total---	--	--	3,888	July 23 - August 13
Grand total---	--	--	7,303	July 5 - August 13

The third instar of the host is preferred for parasitization by this species. In general, releases this year were delayed somewhat beyond the release date optimum for the season. The average optimum 7-day period (or the average 7-day period after the first host larvae pass into the third instar) for release of this species was found to be June 23-29 in the two-generation area (data from New England), and July 19-25 in the one-generation area (data from Ohio). The actual synchronization obtained this season, is shown in charts 1 to 4, inclusive. These charts show that 85 percent of the releases in the Middle West and those in Connecticut were made after the period of maximum host abundance had passed, but, that in northwestern New York and in New Jersey the parasites were in the field before the peak of the preferred instar. However, in all cases, except the release in Albany County, N. Y., the liberated adults should have found favorable host instars present in the field at the time of their release.

2. Lydella stabulans var. grisescens R. D. (Tachinidae):

A total of 92,922 adults of this species were released in 41 colonies, 39 of these being dispersion colonies. One test colony of this species was started in Atlantic Township, Monmouth County, N. J., and one in Lee Township, Accomac County, Va. Table 4 summarizes the releases of this species and map 2 shows the extent of colonization prior to 1935 and the localities that received releases during that season.

Chart 1

Extent of synchronization of Inareolata punctoria releases
in New York, with presence of preferred host stage

The percent of the total parasites released is indicated in the circles, the horizontal position of which indicates the date of release. Their vertical position has no significance. The number outside of the circle is the number of parasites released.

(Host data from Rochester, N. Y., Field Station)

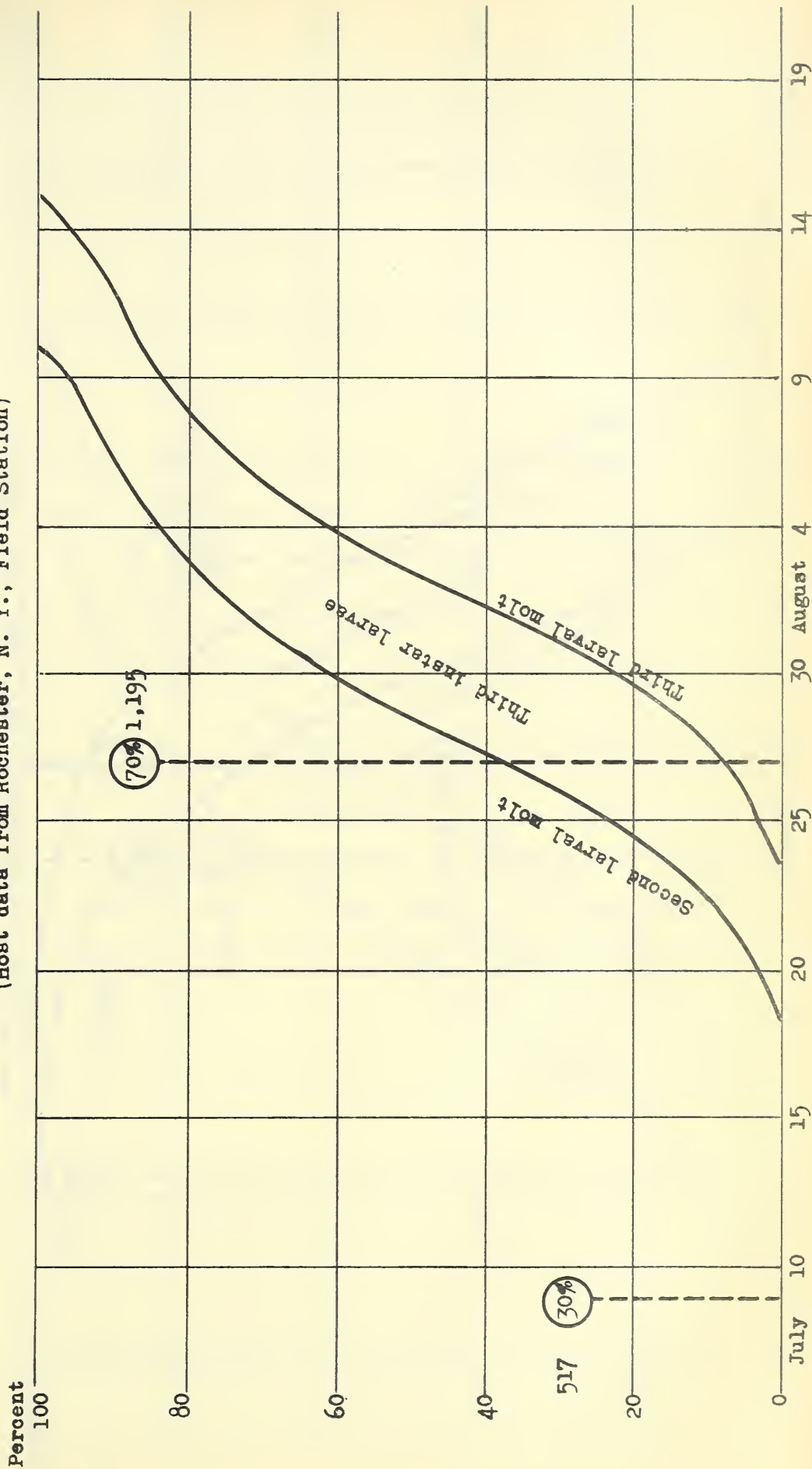


Chart 2

Extent of synchronization of Inareolata punctoria releases
in Ohio, with presence of preferred host stage

The percent of the total parasites released is indicated in the circles, the horizontal position of which indicates the date of release. Their vertical position has no significance. The number outside of the circle is the number of parasites released.

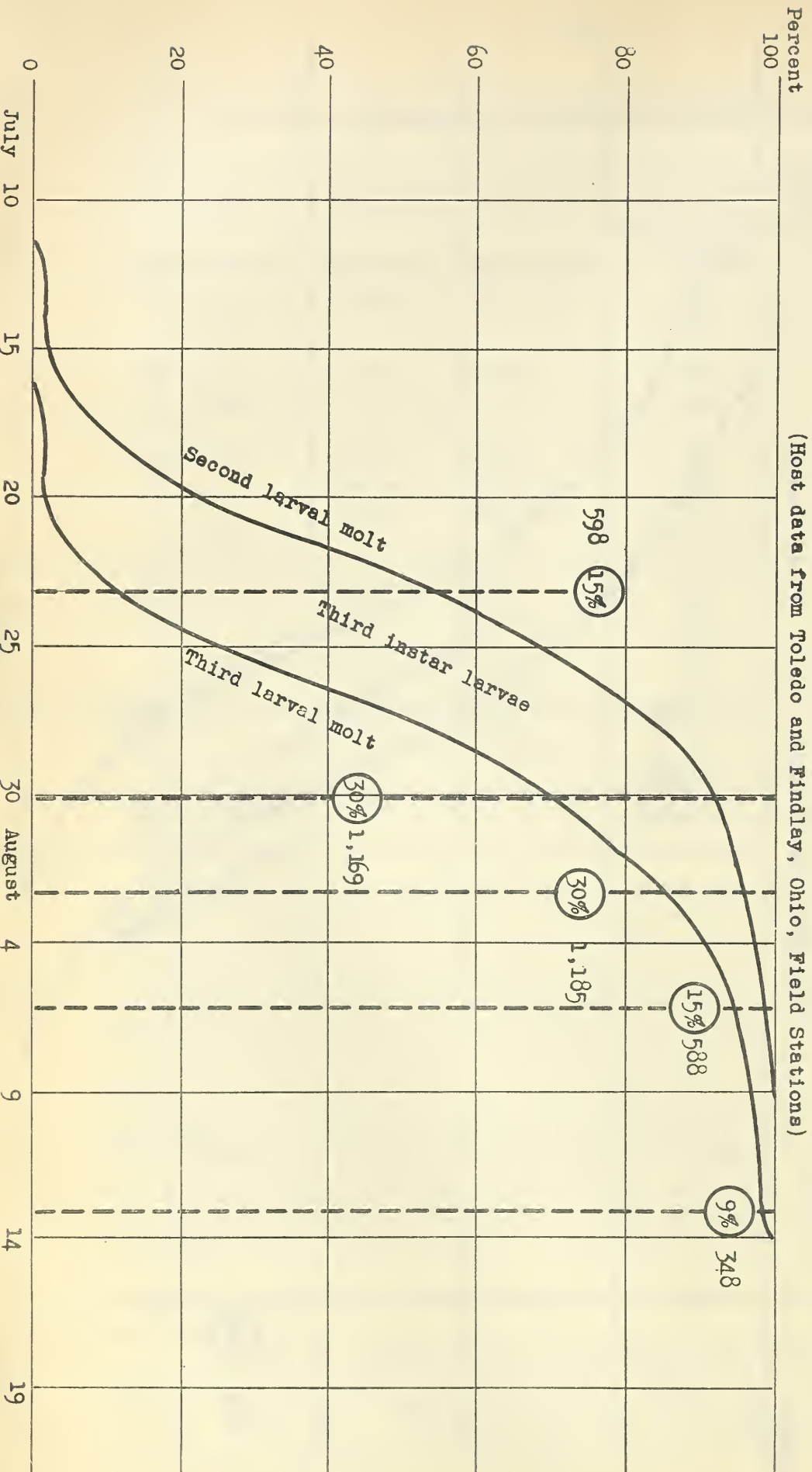


Chart 3

Extent of synchronization of Inareolata punctoria releases
with presence of preferred host stage

The percent of the total parasites released is indicated in the circles, the horizontal position of which indicates the date of release. Their vertical position has no significance. The number outside of the circle is the number of parasites released.

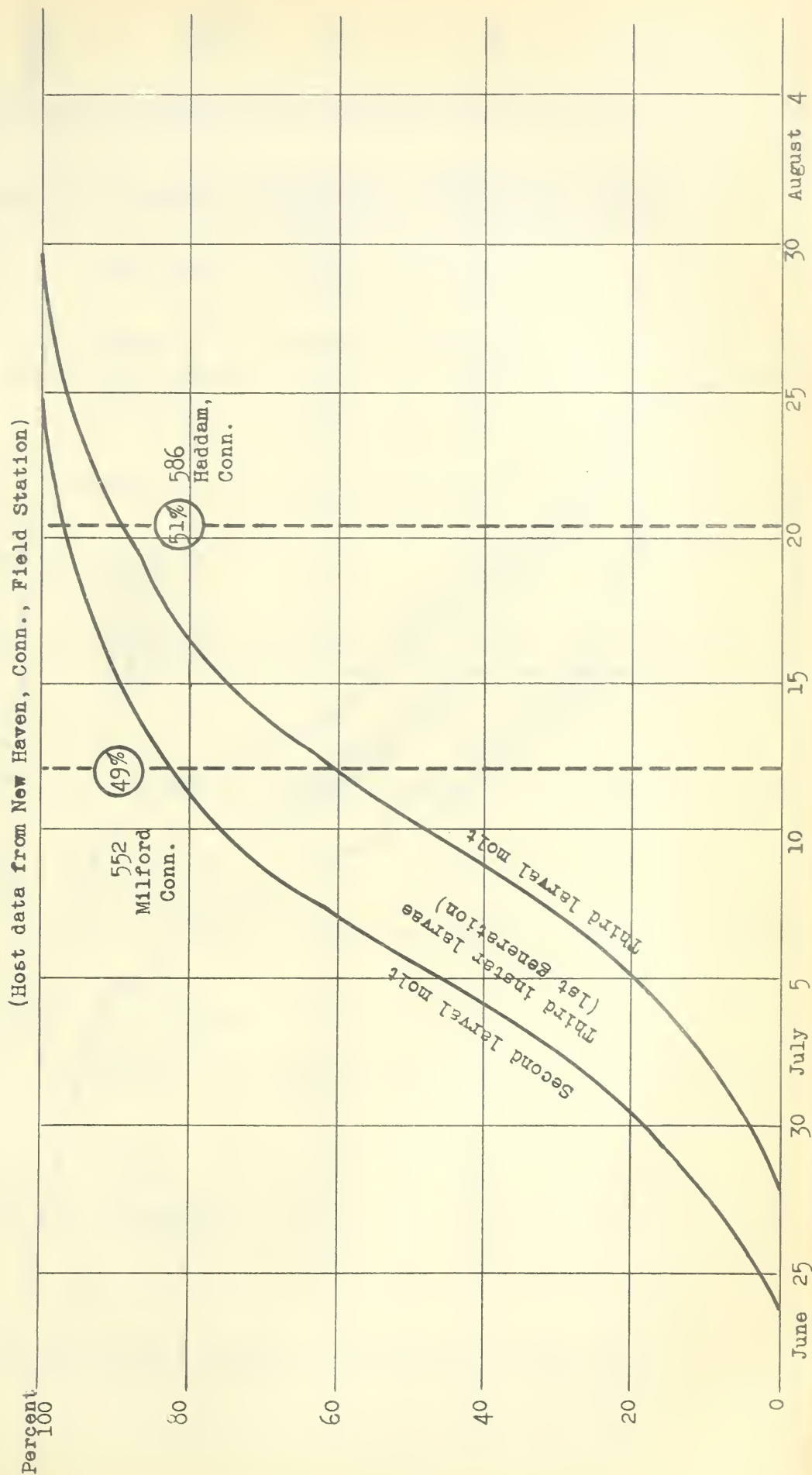


Chart 4

Extent of synchronization of Inareolata punctoria releases
in New Jersey, with presence of preferred host stage

The percent of the total parasites released is indicated in the circles, the horizontal position of which indicates the date of release. Their vertical position has no significance. The number outside of the circle is the number of parasites released.

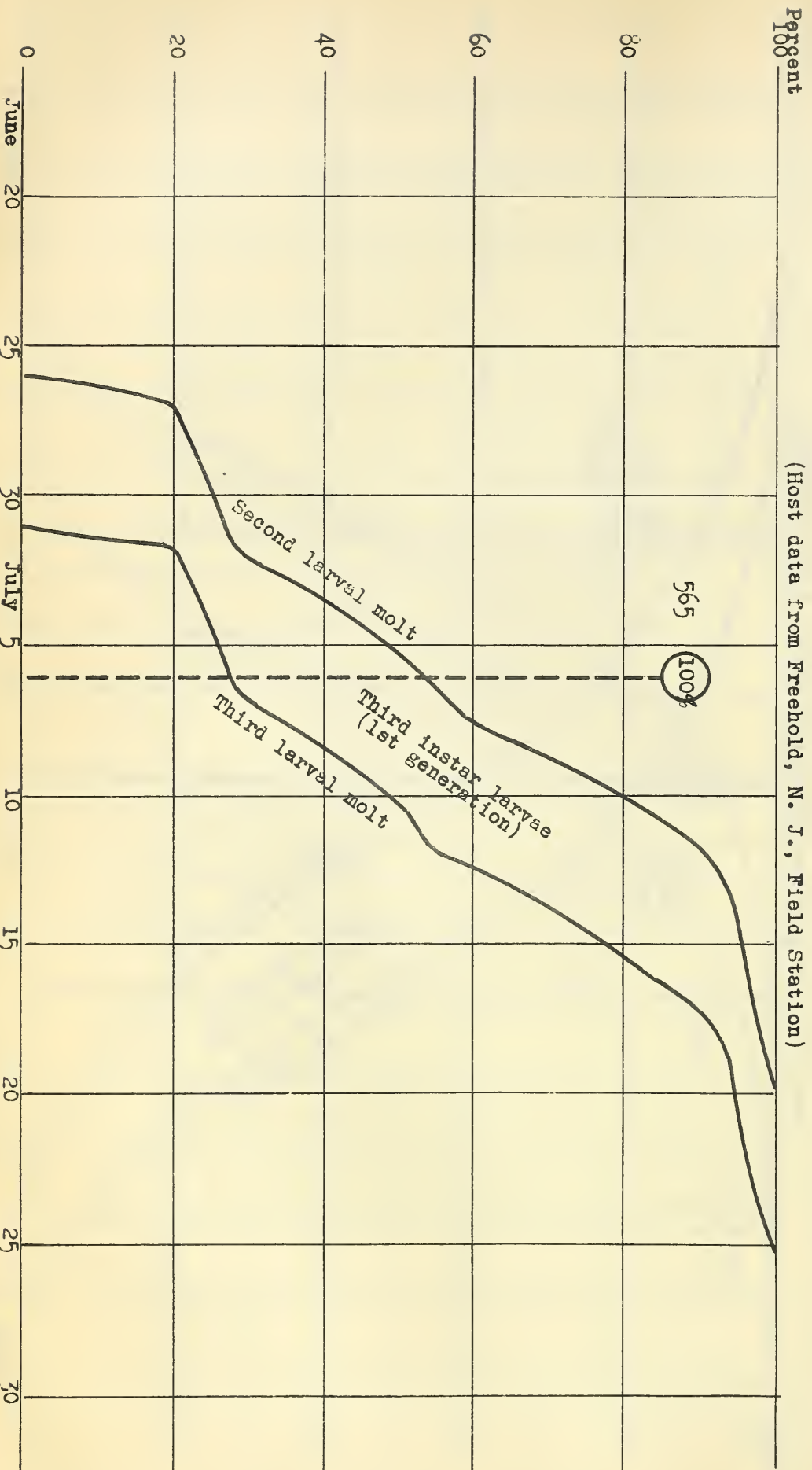


Table 4.--Releases of *Lydella stabulans* var. *grisescens* R. D. in 1935

State	Township	County	Parasites : liberated : Number	Period of release (Dates inclusive)
Connecticut----	Haddam	Middlesex	1,823	July 2
Total----	---	---	1,823	Do.
Indiana-----	Union	Adams	3,974	July 10
	Clear Creek	Huntington	3,966	Do.
	Union	Whitely	3,964	Do.
Total----	---	---	11,904	Do.
Maine-----	Wells	York	1,927	June 18
Total----	---	--	1,927	Do.
Massachusetts-	Barnardston	Franklin	1,906	July 6
	Agawam	Hampden	1,934	June 25
	Hadley	Hampshire	1,949	July 6
	Charlton	Worcester	1,935	June 25
Total----	---	--	7,824	June 25 - July 6
Michigan-----	Sabawaing	Huron	1,995	July 9
	Goodland	Lapeer	1,992	Do.
	Lexington	Sanilac	1,993	Do.
Total----	--	--	5,980	Do.
New Hampshire-	Hollis	Hillsboro	1,782	July 6
	Raymond	Rockingham	1,883	June 18
	Stratford	Stratford	1,904	Do.
Total----	---	--	5,569	June 18 - July 6
New Jersey----	Egg Harbor	Atlantic	1,997	June 17
	Woodland	Burlington	503	(*)
	Atlantic	Monmouth	1,980	June 16
	Brick	Ocean	1,976	Do.
Total----	--	--	6,461	June 16 - 17
New York-----	Berne	Albany	1,983	July 9
	Mayfield	Fulton	3,913	Do.
	Palatine	Montgomery	3,901	Do.
	Jefferson	Schoharie	1,970	Do.
Total----	--	--	11,767	Do.

*Release point for early and late emerging individuals. Small lots.

Table 4. Releases of *Lydella stabulans* var. *griseszens* R. D. in 1935 (Cont'd)

State	Township	County	Parasites liberated	Period of release (Dates inclusive)
			Number	
Ohio-----	Moorefield	Clark	1,991	July 19
	Liberty	Delaware	1,996	July 9
	Pike	Knox	1,995	Do.
	Avon	Lorain	1,996	July 19
	Pike	Madison	2,996	July 10
	Stokes	Madison	2,993	Do.
	Jefferson	Mercer	1,983	July 12
	Newberry	Miami	1,992	Do.
	Westfield	Morrow	1,997	July 9
	Jackson	Shelley	1,992	July 12
	Marlboro	Stack	1,976	July 6
	Canaan	Wayne	1,991	Do.
Total--	--	--	25,898	July 6 - 19
Vermont-----	Grand Isle	Grand Isle	3,960	July 17
	Poultney	Rutland	1,961	June 19
	Middlesex	Washington	1,953	Do.
	Bridgwater	Windsor	1,939	Do.
Total--	--	--	9,813	June 19 - July 17
Virginia-----	Lee	Accomac	1,977	June 15
	Franktown	Northampton	1,979	Do.
Total--	--	--	3,956	Do.
Grand total--	--	--	92,922	June 15 - July 19

This tachinid normally has a preoviposition period of from 10 to 14 days. The fourth instar is the optimum stage of the host for successful oviposition by this species, therefore, it is desirable that releases be made from 10 days to 2 weeks before borers in the field start to enter this instar. For the two-generation area this period was considered to be the week of June 20-26 and for the one-generation area the week of July 12-18. These periods were calculated from data on average seasons in New England and Ohio. The extent of synchronization of parasites with their preferred hosts and the extent to which the 1935 season approached the average is presented in charts 5 to 9, inclusive. These charts show that releases in practically all cases were nearly ideal. The 3,960 adults released at Grand Isle, Vt., (Chart 7), would probably synchronize very well with the single-generation larvae that normally occur there.

3. Cremastus flaviorbitalis (Cameron) (Ichneumonidae):

Five colonies of this parasite were released in the more southern parts of the two-generation area, including one at each of the test points in Connecticut, New Jersey, and Virginia. Table 5 summarizes the releases

Chart 5

Extent of synchronization of Lydeella stabulans var griseus releases with presence of preferred host stage. Vicinity of Albany, N. Y.

The percent of the total parasites released is indicated in the circles, the horizontal position of which indicates the date of release. Their vertical position has no significance. The number outside of the circle is the number of parasites released.

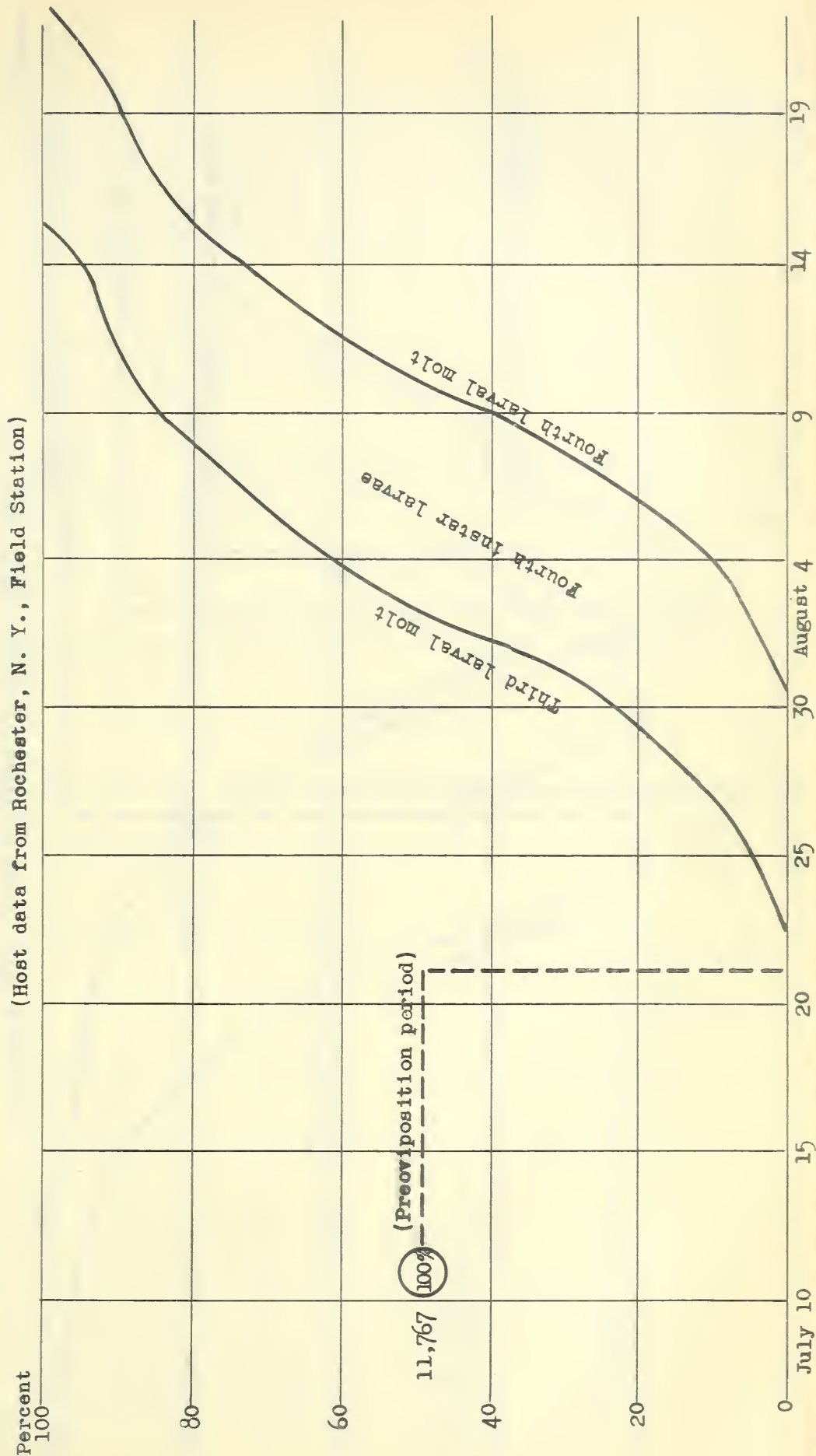


Chart 6

Extent of synchronization of Lydella stabulans var grisescens releases
with presence of preferred host stage. Middle West releases.

The percent of the total parasites released is indicated in the circles, the horizontal position of which indicates the date of release. Their vertical position has no significance. The number outside of the circle is the number of parasites released.

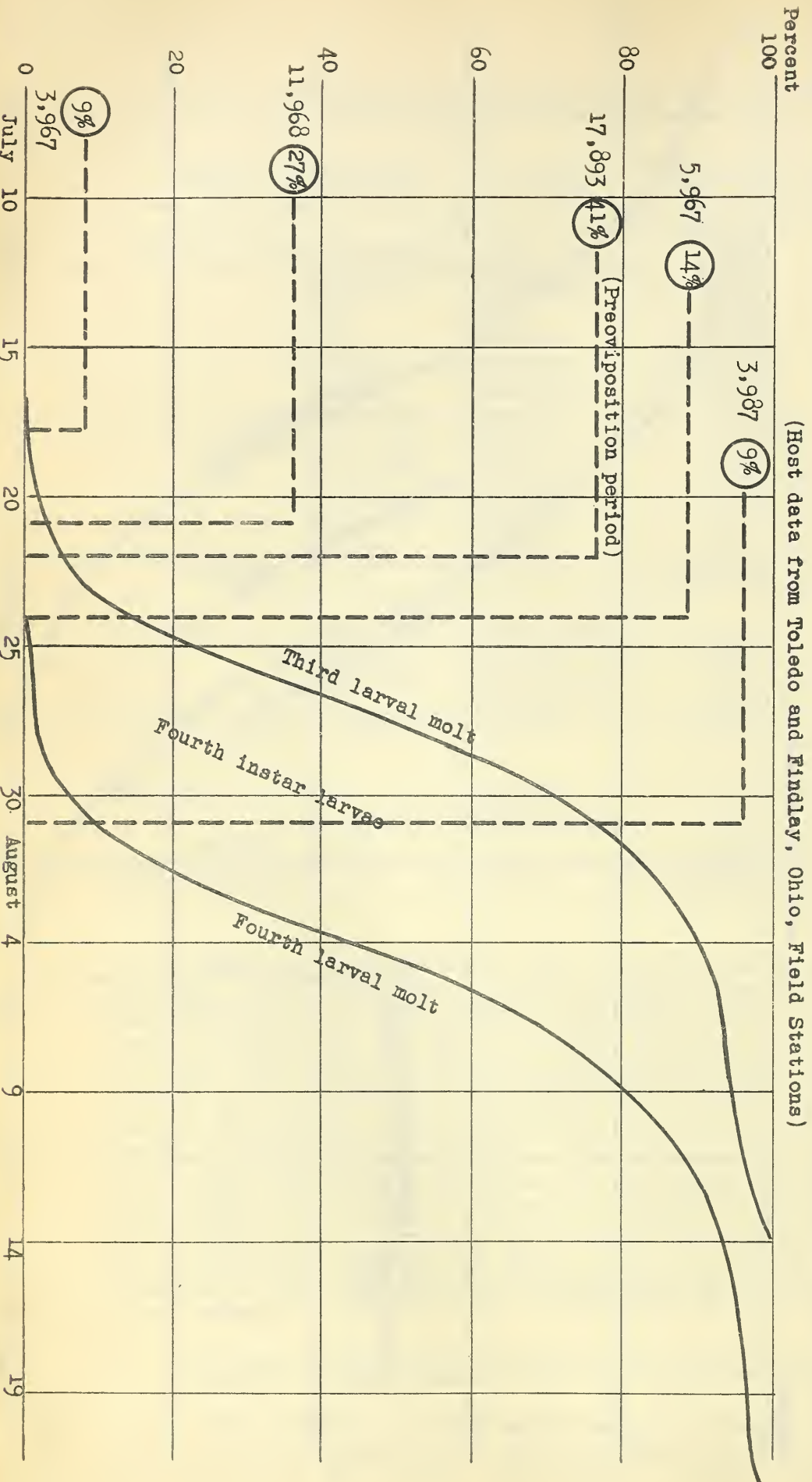


Chart 7

Extent of synchronization of *Lydella stabulans* var *griseus* releases in Maine, New Hampshire, Vermont, and Massachusetts, with presence of preferred host stage

The percent of the total parasites released is indicated in the circles, the horizontal position of which indicates the date of release. Their vertical position has no significance. The number outside of the circle is the number of parasites released.

(Host data from Melrose, Mass., Field Station)

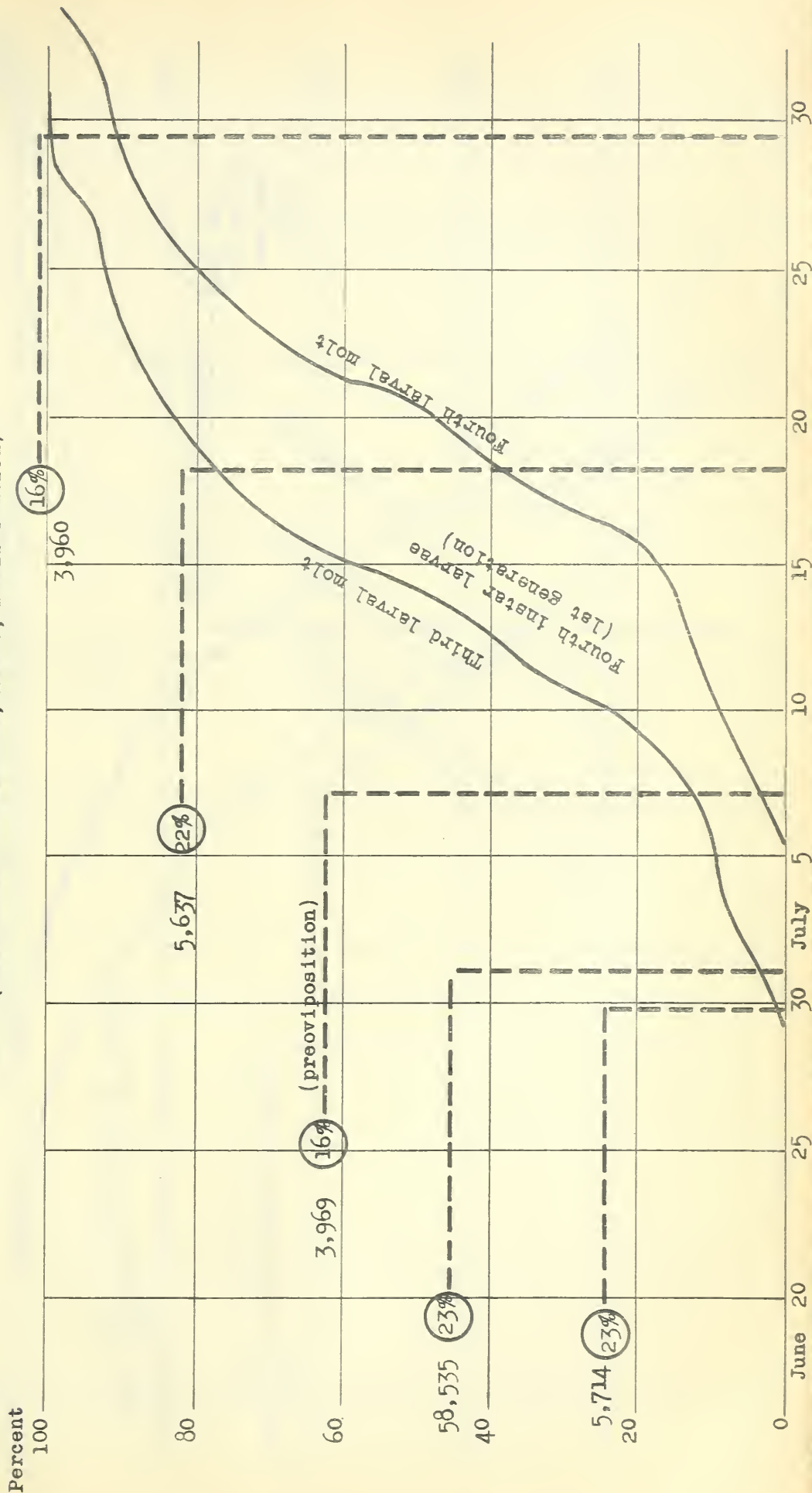


Chart 8

Extent of synchronization of Lydella stabulans var griseus releases
with presence of preferred host stage

The percent of the total parasites released is indicated in the circles, the horizontal position of which indicates the date of release. Their vertical position has no significance. The number outside of the circle is the number of parasites released.

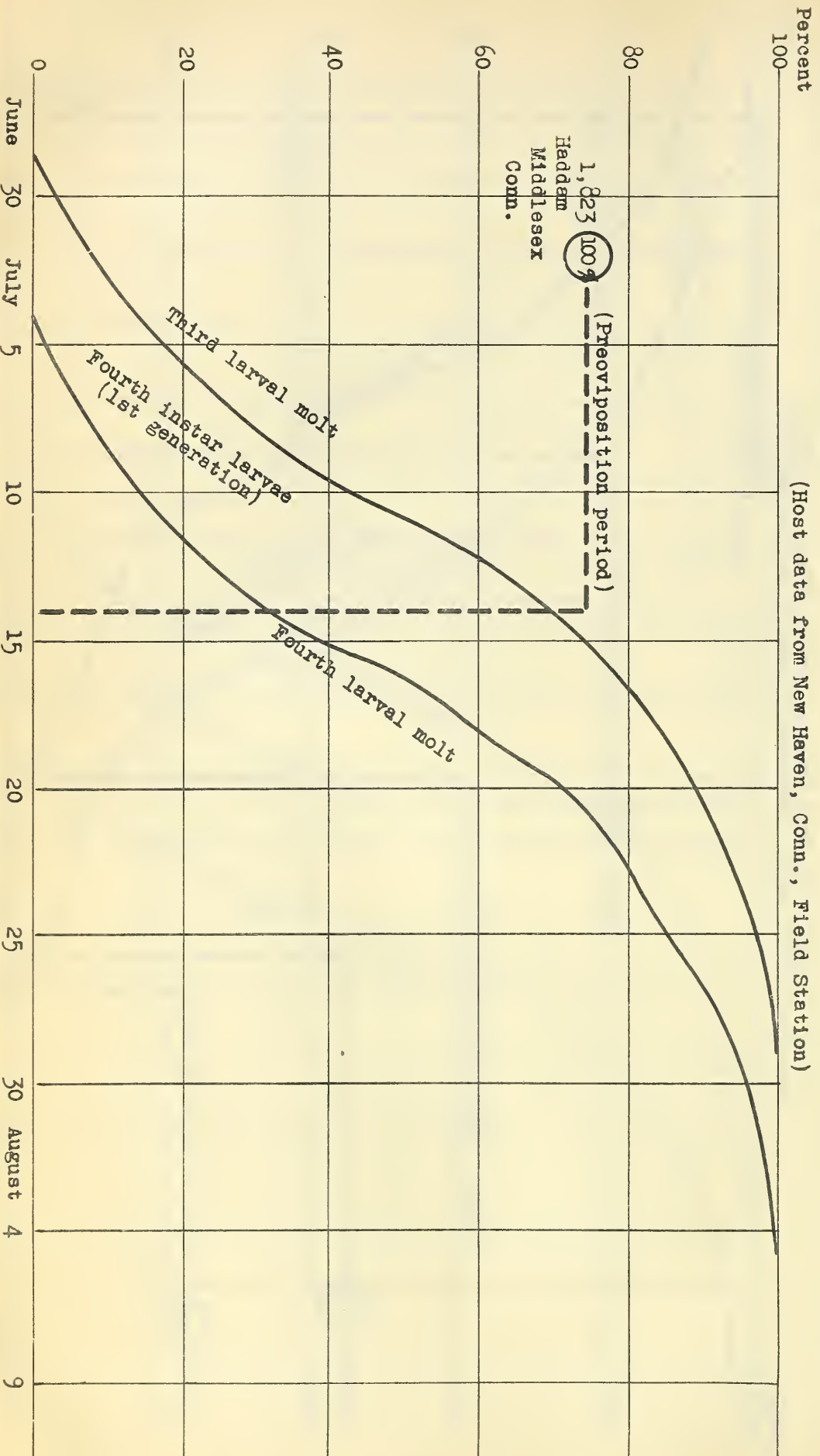


Chart 9

Extent of synchronization of Lydella stabulans var griseus releases in New Jersey, exclusive of Woodland, Burlington, with presence of preferred host stage

The percent of the total parasites released is indicated in the circles, the horizontal position of which indicates the date of release. Their vertical position has no significance. The number outside of the circle is the number of parasites released.

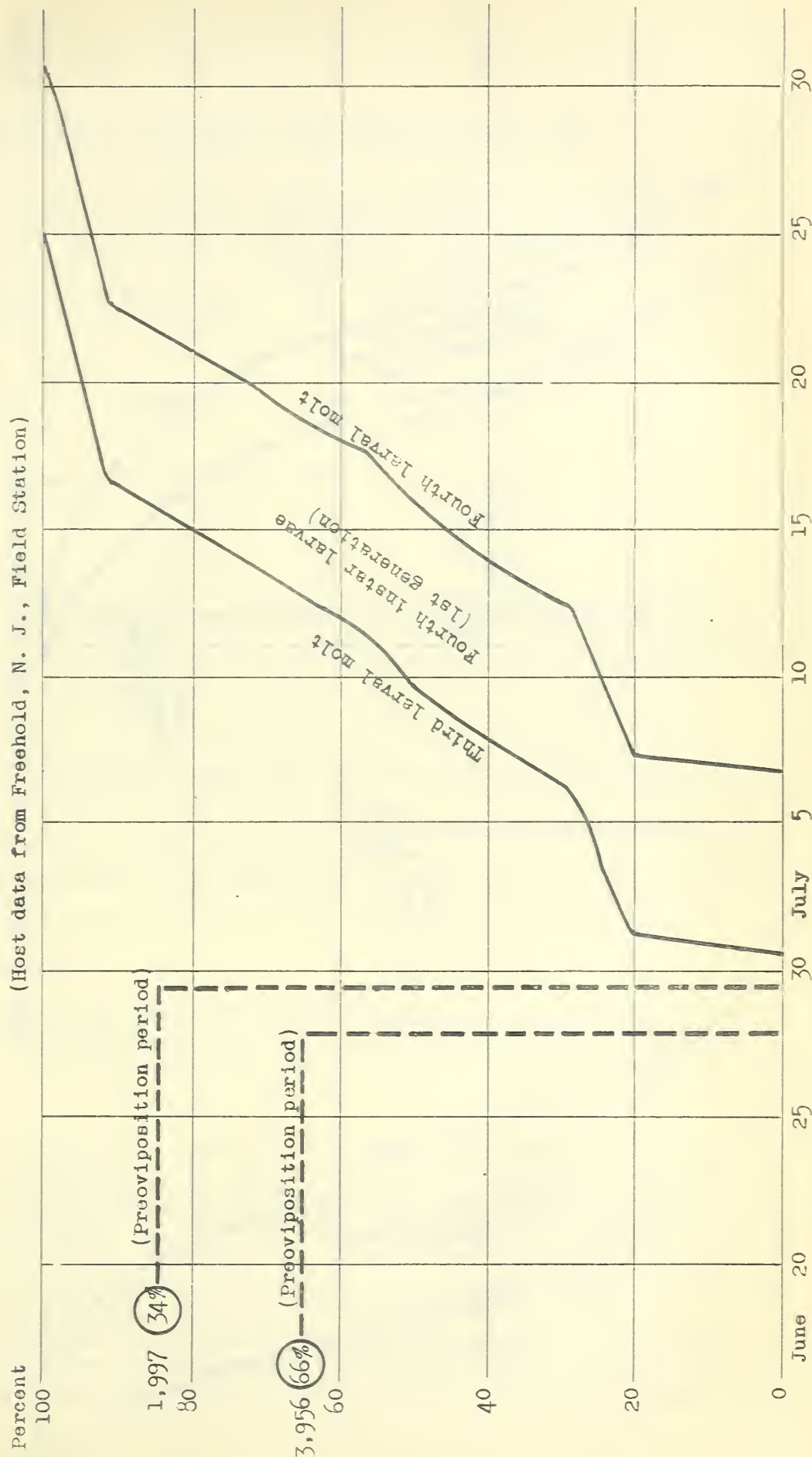
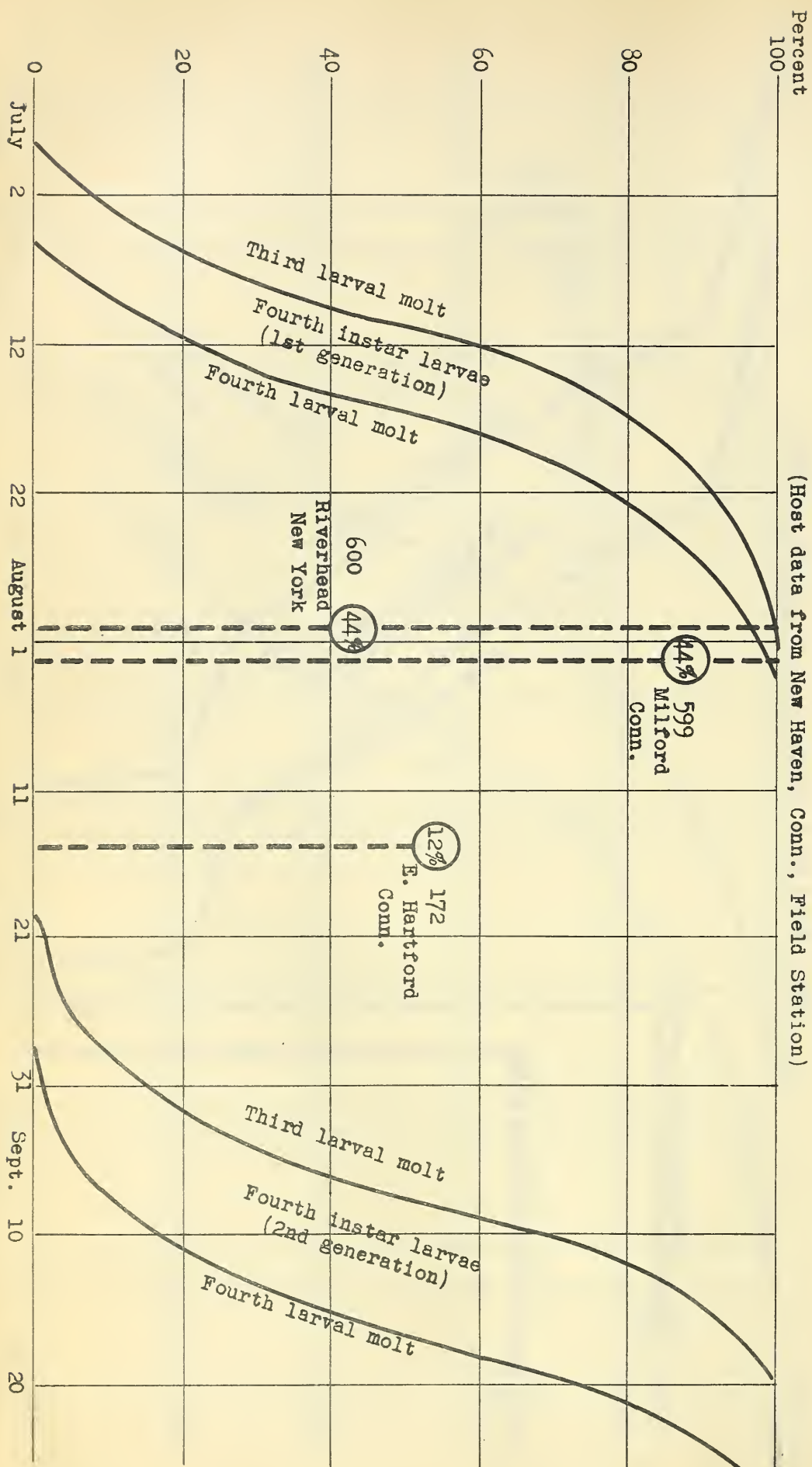


Chart 10

Extent of synchronization of Cremastus flavoorbitalis releases
with presence of preferred host stage

The percent of the total parasites released is indicated in the circles, the horizontal position of which indicates the date of release. Their vertical position has no significance. The number outside of the circle is the number of parasites released.



of this species in the United States. This species was previously colonized in Lucas and Henry Counties, Ohio, and releases were made in 1935 in Hartford and New Haven Counties, Conn., Suffolk County, N. Y., Monmouth County, N. J., and Accomac County, Va.

Table 5.--Releases of *Cremastus flavoorbitalis* in 1935

State	Township	County	Parasites liberated	Period of release (Dates inclusive)
			<u>Number</u>	
Connecticut---	E. Hartford	Hartford	172	August 14
	Milford	New Haven	599	August 1
Total----	--	--	771	August 1 - 14
New Jersey----	Atlantic	Monmouth	593	August 5
Total----	--	--	593	Do.
New York-----	Riverhead	Suffolk	600	July 30
Total----	--	--	600	Do.
Virginia-----	Lee	Accomac	600	July 26
Total----	---	--	600	Do.
Grand total--	--	--	2,564	July 26 - August 14

It was anticipated that practically all adults of *C. flavoorbitalis*, estimated to become available for colonization, would be forwarded to Belleville, Ontario, for release in Canada. Therefore, emergence was planned to synchronize with the development of the one-generation strain. However, emergence greatly exceeded expectation, permitting a number of releases to be made in the more southern districts of the infested area in the United States. While optimum synchronization was not accomplished, it is hoped that sufficient contact was made to furnish an estimate of the possibilities of this species in the respective environments. Chart 10 shows this synchronization.

Miscellaneous species:

Seven adults of the oriental braconid *Bracon atricornis* Smith were released on August 14 at the test point in East Hartford Township, Hartford County, Conn.

Conclusions:

The season of 1935, in general, is considered to have been much more favorable for the colonization of parasites than that of 1934, because of less prolonged periods of dry, hot weather. The maps accompanying this report show that colonies of the tachinid *Lydella stabulans* var. *grisescens*, more or less widely spaced, have been placed over practically the entire area carrying corn borer populations of sufficient density to be considered capable of enabling the parasite to be successfully established.

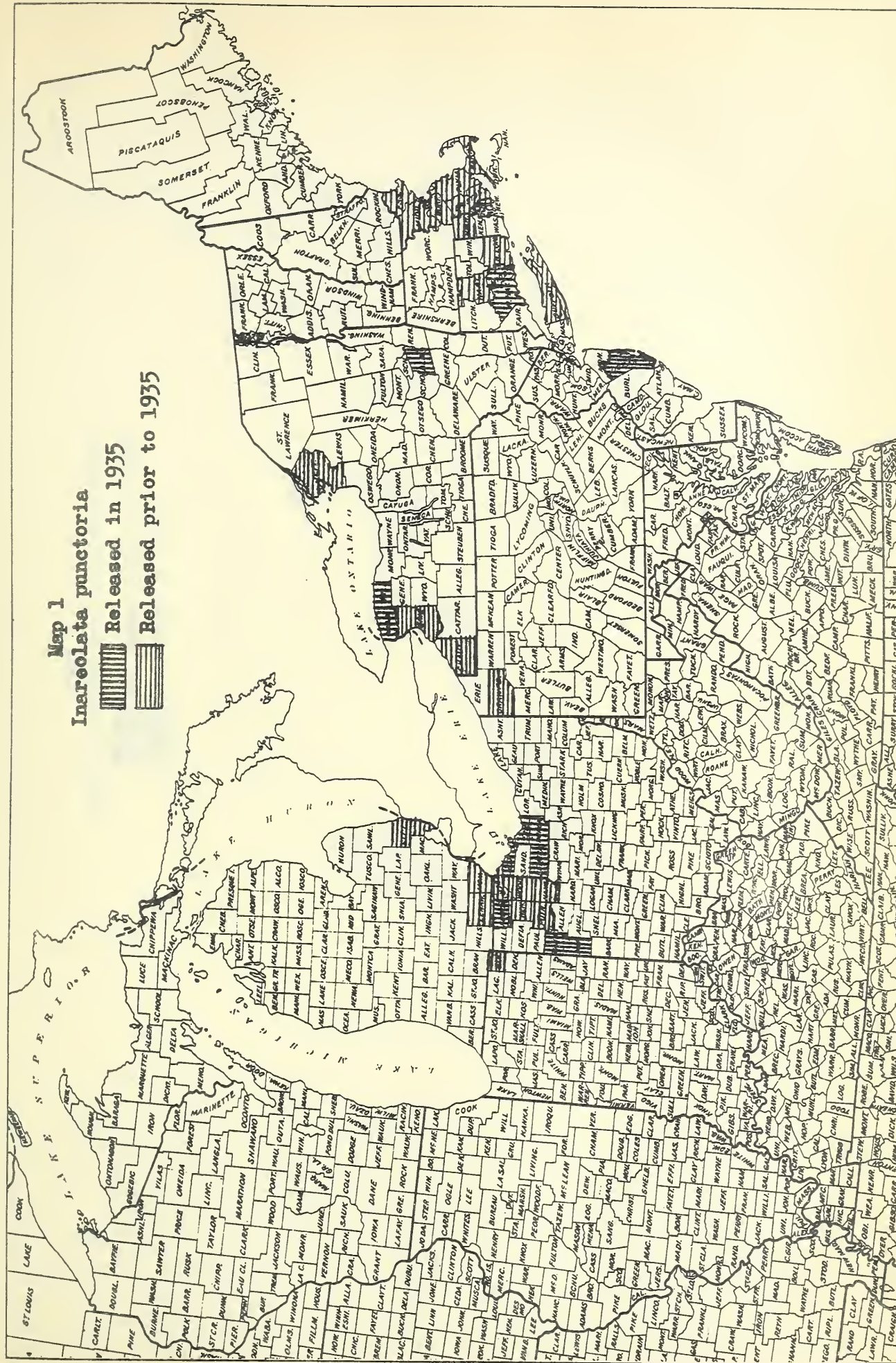
In the case of the ichneumonid *Inareolata punctoria* while considerably less territory has been colonized, with the completion of the current season's releases, these colonies have been extended to the more lightly infested areas.

Map 1

Inareolata punctoria

Released in 1935

Released prior to 1935



Map 2
Lydella stabulans var *grisescens*
 Releases prior to 1935
 Releases in 1935

